PROGRESS OF THE BARBERRY-ERADICATION CAMPAIGN IN SOUTH DAKOTA, 1928

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Barberry eradication has been found to be an effective means of reducing the losses to small-grain crops caused by black stem rust. The task of locating and destroying common barberry bushes has been carried on in South Dakota, and 12 of the other small-grain States in the north-central portion of the United States, for almost 11 years. During this time more than 132,000 barberries have been destroyed on nearly 1,300 farm and city properties in South Dakota, while more than 17,500,000 of these rust-spreading bushes have been eradicated in the 13 States engaged in barberry eradication. (See map on last page of this report.)

The losses from black stem rust are gradually being reduced in inverse proportion to the total number of barberries destroyed. Reliable estimates by the United States Department of Agriculture place the average loss in the six years from 1915 to 1920 at more than 50,000,000 bushels of wheat per year. This was before many barberries had been destroyed in the area. In the 8-year period from 1921 to 1928 the average annual loss has been reduced to less than 16,000,000 bushels of wheat, a reduction of 34,000,000 bushels on the average each year. Other control measures, including the breeding of varieties resistant to stem rust, the use of early-maturing varieties, and the sowing of crops early, have aided barberry eradication in accomplishing these results.

While great progress has been made in reducing the losses caused by black stem rust, much more remains to be done before the final goal is reached. It undoubtedly will be many years before the barberries are entirely cleaned out of South Dakota and even longer before they are all found and destroyed in some of the other States. Plant breeders have made good progress in their work of developing varieties of grain resistant to stem rust, but much more work remains to be done before varieties adapted to the various soil and climatic conditions of the grain-growing States, and varieties suitable for milling purposes, are produced.

These two control measures, barberry eradication and the breeding of rust-resistant varieties, show the greatest promise in reducing losses from stem rust. Work along these two lines should proceed simultaneously and in harmony in order to accomplish the greatest results.

Organization

The demand for relief from the increasing losses caused by stem rust resulted in the legislation against common barberry bushes and the organization of a campaign to find and destroy these bushes. Early in 1918 the present organization, cooperative between the United States Department of Agriculture and the 13 North-Central, grain-growing States, was affected. Prior to this time, in 1917, North Dakota began the eradication of common barberries. By 1919 laws or other regulations prohibiting the growing of barberries became effective in each of these 13 States.

The barberry-eradication campaign in South Dakota is directed by a State Leader under the supervision of the Office of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C., and in cooperation with the South Dakota State College, the State Department of Agriculture, and other State and civic organizations. The Conference for the Prevention of Grain Rust, Minneapolis, composed of representatives of agricultural and allied interests, cooperates closely with the campaign.

As it is under Federal supervision, barberry eradication has been financed largely by Federal funds. Since the beginning of the work only $15,000 in money has been furnished directly by the State. During the same period more than 12 times as much has been received from the Federal Government. Splendid support and some valuable indirect aid have been given by various organizations and institutions within the State. This year farmers' organizations, elevator companies, chambers of commerce, bankers, American Legion chapters, machinery companies, school-supply houses, and other organizations furnished more than $800 for prize money in connection with an educational project in barberry eradication.

State aid is necessary in order that adequate Federal funds may be received to carry on the work in this State. A part of the Federal appropriation must be matched by State funds. The total cost to the Federal Government and the State for finding and destroying more than 132,000 barberries in South Dakota has been approximately $3.00 per farm. On the other hand, the annual stem-rust loss in this State is estimated to have been about $125 per farm during the last ten years. In certain years, prior to the time that barberry eradication was started, the average loss was approximately $800 per farm.

The activities of the campaign are directed along four major lines: (1) Surveys, (2) eradication, (3) publicity and education, and (4) investigation.

Surveys for Barberries

Several types of survey have been used in finding barberries in South Dakota. These are the first or preliminary survey, the second survey, and the resurvey. In some counties a check or third survey is necessary.

The first or preliminary survey was a property-to-property survey in cities, towns, and villages and a farm-to-farm survey of all rural properties in the State. The purpose of this survey was the destruction of the largest number of bushes in the shortest possible time. Every barberry destroyed lessens the chance of stem-rust infection. Therefore, at the beginning of the eradication campaign more emphasis was placed on destroying a large number of bushes than on getting every bush as the survey progressed. The first survey was completed in 1924.

The second survey is more intensive than the first. At the present time on this survey every foot of every property upon which barberries may be growing is searched for barberries. The field agents on the second survey locate not only the straggling bushes missed on the first survey, but also the new bushes which have grown from seeds scattered from the planted bushes by birds or other agencies.

Some one may ask if it would not have been better to have gone slowly on the first survey and taken time to find every bush. Had that plan been followed, only a small portion of the State would have been covered yet, and all of the bushes in the unsurveyed portion would have been causing damage during all this time. As it was carried on, the greater portion of the bushes was found and eradicated within a few years. Naturally some bushes were missed on the first survey, and these are capable of doing damage, but the chance of great damage was reduced materially in a few years by speeding up the work and covering the whole State.

Resurveys are reinspections of the properties on which barberries have been found and destroyed. Such resurveys are necessary to find and kill sprouts and seedlings developing where bushes were destroyed in the first or second surveys.

A check, or third survey is necessary in some of the first counties that received a second survey. In these counties it was not deemed advisable to cover every foot of ground thoroughly. Since that time it has been found essential to cover all natural and planted timber, and all fence rows on second survey. This naturally slows up the progress of the work, but is necessary to locate all straggling bushes that were missed in former surveys.

Difficulties of Survey

The task of finding every barberry in South Dakota is not as simple as it might at first appear. Every foot of planted and natural timber, as well as all fence rows, must be covered carefully. Barberries have been found in many unusual places which include the crevices of the precipitous cliffs of the Black Hills, in dense thickets of wild currants, gooseberries, and plums, under tangled arbors of wild grapes and poison ivy, among the sumach bushes along the various river banks, and in almost every imaginable place.

Even if the scouting is done so carefully that no bushes are missed in a county there is still danger that barberry seeds lying in the ground will germinate and grow in future years. This makes it necessary to cover some counties several times before they can be pronounced entirely free from these rust-spreading bushes. The job in this State is not nearly complete. Years will have passed before the last barberry is found in South Dakota.

Eradication

Prior to 1923 the problem of completely eradicating barberries was not an easy one. Bushes were grubbed out with spades, with hoes, and with the pickax. Teams and tractors also were used to pull many bushes. However, this method of eradication proved to be very ineffective and costly. Small portions of the roots left in the ground grew again, causing sprouting bushes where the mother barberries had been destroyed. Thus it was necessary to return the following year and dig the sprouting bushes.

Kerosene and crushed rock salt have since been found to be effective and cheap killing agents. Relatively few bushes sprout when either of these two chemicals is properly applied. In some cases it is still necessary to dig barberries which are

found near valuable trees and shrubbery because kerosene and salt will kill trees and other shrubbery as readily as barberries.

Publicity and Education

Publicity and education include the job of telling the barberry and stem-rust story to the people of the State. Some information must accompany the surveys to acquaint the public with the purpose and progress of the work. The purpose of publicity is to reach the public quickly and to secure the support and cooperation necessary for a successful survey. Materials designed to teach the public how to identify the common barberry and stem rust are all a part of publicity. Extensive use is made of news stories, window displays, exhibits, demonstrations, bulletins, circulars, and circular letters. Talks, many of which are supplemented with lantern-slide pictures and motion-picture films, are given at various gatherings.

The educational work teaches the children in the schools and colleges how to recognize the common barberry and a real knowledge of the cause of black stem rust. Splendid cooperation is received from the State Department of Public Instruction, the county superintendents, and the various teachers. The universities, colleges, normal schools, and teachers' colleges also are aiding in this work. The instructors and teachers are furnished lesson plans, bulletins, circulars, charts, specimens of barberry and of rust, and other material to aid them in teaching the story of stem rust and the common barberry. Some educational work also is carried on through children's organizations such as the Boys' and Girls' Clubs and the Young Citizens League.

One of the biggest problems of the barberry eradication campaign is to teach people to know the common barberry and to understand how it spreads black stem rust. The idea that "weather" causes rust is still held by some people. Others can not understand that a single, innocent-looking shrub should do so much harm.

Favorable weather is necessary for the development of the rust but does not cause it. Stem rust is caused by a tiny seedlike, reproductive body, known as a spore. This spore begins its growth on the leaves of the common barberry in the spring, where it develops for a short period and is then spread to grains and grasses, and it may cause serious loss if the weather is favorable for its rapid growth. Thus the weather certainly aids the development of rust, but it does not cause the disease. The right kind of weather is necessary to grow a crop of small grain, but no harvest would be threshed if the seed were not sown. The same is true of stem rust. No rust would be present if the small reproductive spores were not sown on the grains and grasses by common barberry bushes.

One small barberry may be responsible for severe damage. A few spores spread from a single bush may multiply very fast under favorable weather conditions. Once off the barberry bush, stem rust spreads rapidly from one grain field to another until a whole township, county, or larger section of a State may be rusted from one small bush.

Investigations

The chief investigational work carried on in South Dakota includes a study of stem rust. Surveys are made each year to determine the prevalence and severity of stem rust and the damage that it has caused to small-grain crops. Studies on the epidemiology of stem rust are carried on in order to determine what influence the weather and other growth factors may exert in bringing on an epidemic of this disease. The spread of stem rust from barberries to susceptible grains and grasses also is watched. The probability of stem-rust epidemics from inoculum blown into the State, and the possibility of overwintering the red stage of this disease in South Dakota and its return to small grains and grasses without the aid of the barberry, are given attention. The information thus far obtained in these studies indicates that the common barberry is the main source and probably the only important source of stem rust in this State.

The U. S. Department of Agriculture and the experiment stations in other States in the eradication area carry on investigations which include: (1) the classification of barberries and other closely related plants; (2) the testing of barberry species, varieties, and hybrids for their susceptibility to stem rust; (3) studies in connection with the problem of chemical eradication; and (4) the longevity of barberry seeds when buried in the soil.

Summary of all Activities, 1928

Less than three counties were covered in an intensive survey this year. The system of surveying all natural and planted timber, in addition to all fence rows, slowed up the work considerably. The resurvey of old barberry properties was made in connection with the second survey and in areas of known escaped bushes in other counties. A total of 1,249 barberry bushes, seedlings, and sprouting bushes was found during 1928 in 16 different counties, on intensive survey and resurvey.

In addition to the actual survey for barberries, a careful stem-rust survey was carried on this year. In spite of the fact that stem rust did little damage over the State as a whole, this survey was extremely worth while. Several areas of rust infection were found which appeared to be of local origin. The responsible barberries were found in two of these areas, and the others will be investigated as soon as time and funds permit. This season was an especially favorable one in which to note the spread of stem rust from barberries.

Publicity and educational work for the purpose of informing people of the merits and progress of the campaign was continued this year. A special educational project was carried on this year through the Young Citizens League, a grade-school organization. This project consisted of a State-wide competitive essay-writing and speaking contest using "Black Stem Rust and the Common Barberry" as a subject. Prizes for this contest aggregating more than $800 were furnished by farm organizations, elevators, machinery companies, chambers of commerce, American Legion chapters, banks, school-supply houses, and other organizations.

The results of this project exceeded the expectations of those responsible for it. They may be summarized as follows:

A total of 50 counties out of 64 organized counties in South Dakota joined in this contest and 46 of them completed the project in their counties. The names of 6,000 boys and girls from approximately 1,000 schools were received stating that they wanted to join the contest. Undoubtedly many more entered whose names were not received. A conservative estimate indicated that 10,000 boys and girls prepared essays and talks on the subject, while probably 50,000 studied about black stem rust and the common barberry. More than 25,000 people attended the various local, county, and State contests.

Barberries were found as a result of this contest on three different farms. These were found by the school children and were reported to the office of the State Leader. Possibly others may have been found which were not reported.

The newspaper clippings received showed that a total of 225 stories concerning the contest were printed, occupying 108 columns of space. Undoubtedly many stories were printed in papers from which no clippings were received. Most of the stories were written by local editors interested in the contest. Practically every issue of the Journal of Education in South Dakota contained a story concerning the project. Several papers included a copy of the prize-winning essays in the various county and district meets. The Minneapolis Journal carried a full-page feature story about the contest. Several editors wrote favorable editorials commenting on the project.

A total of 59,900 pieces of educational material was sent out from the office of the State Leader for use in this contest. These consisted of 12,700 circular letters, 2,000 personal letters, 24,450 bulletins, 4,050 lesson plans, 6,600 barberry specimens, 4,050 grain specimens, and 4,050 posters. These were all sent to the various contestants and teachers to aid in preparing the essays and talks. Some additional materials were sent on special request. In several instances barberry exhibits were arranged by the school children in connection with the various contests.

In addition to the Young Citizens League project, the results of the educational and publicity work may be summarized as follows:

A total of 65 demonstrations was held, consisting of fair demonstrations, field demonstrations, and miscellaneous demonstrations. Speakers were furnished for 50 different meetings. Material for study was sent to approximately 5,000 colleges, normal schools, high schools, and grade schools. A total of 387 stories was published in weekly and daily papers, not including 17 stories published in various magazines. Approximately 75,000 pieces of material were sent to the various schools and colleges for use in teaching the story of stem rust and the barberry. These consisted of bulletins, circulars, circular letters, posters, charts, lesson plans, and specimens of barberry and of rusted grain.

Present Status of the Work

(1) The first survey of the entire State was completed at the close of the field season in 1924. A total of 51,256 large barberry bushes and 15,078 seedlings was found on 883 different properties as a result of this survey.

(2) Second survey has been carried on in approximately 30 counties, and as a

result 3,880 barberries have been found on 263 properties. A second survey will undoubtedly be necessary in all of the remaining counties in this State.

(3) A resurvey has followed the first and second survey for the purpose of checking up on farms and city properties where barberries were found. More than 53,000 sprouting bushes and seedlings had grown up from barberry seeds and roots. In addition, 7,498 new bushes and 12,038 seedlings were found on 120 different properties as a result of this survey.

(4) During the entire campaign 132,974 barberries have been found and destroyed on 1,280 farm and city properties in South Dakota.

(5) Education and publicity has helped to clear away some of the skepticism which was manifest early in the campaign relative to the merits of the project. Practically everyone has heard of the barberry eradication campaign and is more or less familiar with the facts regarding it, but much remains to be done before the public in general has a thorough understanding of this activity.

Rust Spreads from Barberries

Many excellent examples of the spread of stem rust from barberries to grains and grasses have been found and recorded in South Dakota. In fact, barberries have been located by tracing the severity of stem rust directly to them. Farmers who lived near to the offending barberry bushes have testified to the damage that these plants have caused.

This year stem rust caused practically no damage in South Dakota over the State as a whole. Yet in Grant County some loss occurred, and in fields adjacent to barberry bushes the loss was as high as 25 per cent. Another similar area was found in Hutchinson County easily traceable to barberries.

Careful checkings each year after the barberries were removed from farms where stem rust was heavy, show that stem rust thereafter has been no heavier on these farms than in the surrounding locality.

Other Cereal Rusts

Stem rust is not the only rust that attacks small-grain crops. Practically every year leaf rust appears on wheat in varying proportions. During 1927 this disease caused serious damage. Occasionally there is an epidemic of crown rust of oats which may cause considerable loss. In addition there are leaf rusts of rye and of barley. Neither of these latter two leaf rusts has been of much consequence so far in South Dakota.

This year flax rust caused as high as 25 per cent loss in some fields. Usually this rust does not cause serious damage, but in certain years it cuts down the yield materially.

It should be thoroughly understood that barberry eradication will not control any of these leaf rusts It is a control measure for stem rust only. Breeding for

rust resistance offers the best possibility for controlling these diseases. Leaf rust and stem rust are somewhat similar in appearance but are entirely different diseases. Careful identification is necessary before a rust is called either leaf rust or stem rust.

Other Control Measures

In addition to eradicating barberries, there are other control measures for stem rusts. These include the breeding of resistant varieties, the use of early-maturing varieties, and the early sowing of crops. All of these measures should be continued simultaneously with barberry eradication wherever possible. Barberry eradication and the breeding of rust-resistant varieties both offer great possibilities for the control of stem rust. These two lines of attack on the rust problem should continue in harmony until the losses from this disease are reduced to a minimum.

Conclusion

As early as 1891 severe local attacks of stem rust were known in the United States. In 1904 there was an epidemic of stem rust so severe and so widespread that it was of national importance. Again in 1911 a general loss occurred from stem rust, and in 1916 an extremely destructive epidemic occurred in the upper Mississippi Valley, causing an estimated loss of more than 180,000,000 bushels of wheat.

Stem rust became a limiting factor in small-grain production. Wheat was abandoned in many sections of the United States. Barberry eradication was started in 1918 to reduce the losses because of the demands made by grain growers. This was not a new idea, because campaigns to eradicate barberries had been carried on by many European countries with splendid success. Laws were passed in some of the New England States as early as 1775 prohibiting the growing of common barberries. The part that the barberry played in spreading stem rust was definitely known as early as 1865.

While it will take some time to find and destroy all of the barberries in the North-Central States, the task is not hopeless. Losses from stem rust have been decreased, and may be reduced to a minimum if every citizen of the various States will put his shoulder to the wheel and help in this control measure for the most destructive disease of small-grain crops. Whenever a shrub is found which is believed to be common barberry, a sample of it should be sent for identification to the Barberry Eradication Office, South Dakota State College, Brookings, S. Dak.